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JOINT DISCUSSION No. 2.

Section of Medicine and Section of Surgery

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DISCUSSION ON THE SURGICAL TREATMENT OF ANGINA PECTORIS

Dr. Geoffrey Bourne : In no other branch of clinical medicine is diagnosis more often difficult than in patients suffering from cardiac pain. Here is an account of three patients I have seen.

A man aged 54 suffered from severe pain in the chest which was of two types, acute attacks lasting for a comparatively brief period, and a constant pain which might last for hours at a time. The pain was increased after exertion and after emotion. He was told that he was suffering from " angina pectoris ". Since that time, three years ago, he had done no work. On examining him at St. Bartholomew's Hospital I found that the pain was left-sided, that it was so severe that he was afraid to walk, and his limit seemed to be about 100 yards ; but on careful questioning it was evident that the pain did not vary with the degree of exertion, nor did it diminish when the exertion ceased. It might last for some hours subsequently. My opinion that the pain was of the functional type was borne out by a full clinical, electrocardiographic, and radiological examination. I then sent him to a psychiatrist. Within a month the pain had disappeared. He has since resumed full work as a parquet floor layer, at which he has continued for a period of two years up to the present time.

The second case was a man aged 58. I had seen him two years previously, and had come to the conclusion—again after full examination—that the pain was functional and not of coronary origin. At the time of the second admission to St. Bartholomew's he was treated by alcohol injection, and his previous pain became worse. When I myself saw him subsequently it was still clear that the pain was not coronary in type.

The third case was similar ; he had been treated by sympathectomy. I refused to consider the question of thyroidectomy, which was the point at issue. A psychologist found an advanced degree of obsessional neurosis.

In a ten-years' follow-up investigation of cardiac pain I have met with a number of similar cases. Since diagnosis may thus be difficult for physicians of experience, it is clear that no surgeon should consider treating patients with severe cardiac pain, trusting in his own powers of diagnosis. Statistics of results are not worth publication unless the original diagnosis has been made with extreme care.

No case should be regarded as being suitable investigative material unless classical angina of effort is present. In this condition the pain is strictly quantitative to the degree of exertion undergone. It is increased during exercise, and diminishes as

soon as the patient rests. The question " does exercise make the pain worse ? " is an insufficient question, the point being whether pain is brought on during exercise, not whether pain is produced after exercise ; and further, whether the pain diminishes during rest, or whether it is still felt for a period of possibly hours, although the patient is at rest. Other helpful points are the central position of the pain, relief by nitroglycerin, absence of superficial hyperæsthesia over the chest wall, and changes in the electrocardiogram indicating coronary disease. Here again it must be remembered that the presence of organic coronary disease is of itself not exclusive of a functional type of pain. This functional pain, which is sometimes known as left mammary pain, pseudo-angina, or as I have somewhat provocatively named it, angina innocens, may follow a coronary thrombosis, although, of course, angina of effort is the usual sequel in this case.

Angina of effort indicates insufficient coronary dilatation during exercise, or rigidity or narrowing of the coronary vessels also appearing during exercise.

In angina of effort, the more full the information the higher is the percentage of patients found to have coronary disease. Dr. Bodley Scott and I (*Brit. M. J.*, 1938 (i), 55) in 112 cases of angina of effort, strictly chosen, found only 13 in whom evidence of cardiovascular disease was absent. In a subsequent electrocardiographic investigation Dr. Courtenay Evans and I, also in classical angina of effort (*Lancet*, 1938 (ii). 1354) found in a series of 80 cases no change in the electrocardiogram, in Leads 1, 2, 3, and 4, in 30% of cases. Subsequent examination of these negative cases, by means of exercise or exposure to a temperature of 10% or 12% oxygen, has reduced the percentage of negative cases to about 20%. A number of papers on the post-mortem appearances in cases of angina of effort corroborate this position.

Surgical measures are undertaken for two objects in this condition, relief of pain, and revascularization.

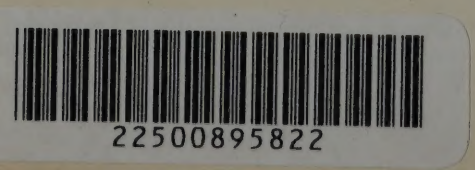
J. C. White, in a long series of patients treated by alcohol injection, concludes that the analgesia produced is harmless, and my own series of 15 cases, treated by thyroidectomy, corroborates his conclusion. Exercise should benefit the hypertrophy and health of the remaining muscle fibres, and should stimulate the re-canalization of thrombosed vessels, and help also to induce re-vascularization of an area previously partially deprived of its blood supply.

My experience of sympathectomy has not been particularly favourable, but, with the newer methods introduced by Professor Ross and others, this opinion will probably need to be revised.

Alcohol injection is attended by the minor accidents of partial pneumothorax and local pleurisy, and by the more unpleasant alcohol neuritis in a few cases.

Thyroidectomy is the surgical measure of which I personally have had most experience. The prominence I give to it here is due to this fact alone. The series of cases which I am showing seem to indicate that thyroidectomy definitely has a place in the treatment of severe cases of anginal pain (Geoffrey Bourne and J. Paterson Ross, *Lancet*, 1938 (ii), 815 ; *St. Barth. Hosp. Reports*, 1938, **71**, 61).

The mode of action of this measure is explained by three different hypotheses. Firstly, it is said to decrease the blood-flow, secondly it is said to be due to injury of the nerve plexuses placed behind the thyroid at the time of operation, and thirdly, it may decrease the sensitivity either of the visceral sensory nerve-endings or of the motor nerve-endings in the coronary vessels. The first of these hypotheses would not appear to stand critical analysis. A patient has very severe pain on walking across a room, dressing, or on experiencing very slight emotion. After thyroidectomy the same patient can carry a suitcase to the station, or can bicycle for 20 miles without pain. Is it conceivable that thyroidectomy has kept the coronary rate of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blood-flow during these exercises below that which previously was produced by dressing ? If not, some other factor must obviously be postulated. Injury to the retrothyroid ganglia was first considered by A. A. Weinstein and H. Hoff (*Surg. Gynæc. and Obstet.*, 1937, **64**, 165), but this does not explain the following observed facts in two of my cases. These two patients were relieved of their pain by thyroidectomy. If they subsequently took too much thyroid extract the pain would return after a lapse of two or three days. When they stopped the thyroid extract, the pain would persist for a further two or three days and would then subside. This would seem to indicate that thyroxin has some visceral sensitizing effect on pain. In my experience thyroidectomy is disappointing in the treatment of congestive failure, but in very carefully chosen cases it is extremely successful in severe angina of effort, whether this condition is complicated by attacks of spasmodic angina or not.

The results are seen in the table.

15 Cases of Very Severe Pain Chosen from about 400 Cases of Angina of Effort (some had Spasmodic Attacks also).

Case, Sex Age at time of Operation	Pre-Operative Course	Alive or Dead	Post-Operative Course			
			Duration	Relief	Result Good, Fair Bad	Remarks
(1) M. 48	2 yrs.	A.	4 yrs.	Complete 1 yr. then very slight pain	G.	Cor. infarct 20 m. after operation
(2) M. 60	2 yrs. 6 m.	A.	3 yrs. 7 m.	Complete 2 yrs. Partial since	G.	Climbed steeples after
(3) M. 47	7 yrs. 6 m.	D.	2 yrs. 3 m.	Complete 9 m. Partial since	G.	Cycled 25 miles daily till 2 m. before sudden death
(4) F. 59	7 yrs. 6 m.	D.	2 yrs. 9 m.	Complete	G.	Previously bedridden with pain. Normal life after
(5) M. 64	9 yrs.	D.	7 m.	Not much relieved	B.	Died of coronary infarction
(6) M. 48	4 yrs.	A.	2 yrs. 2 m.	Complete	G.	Works hard as silversmith
(7) M. 73	8 yrs.	D.	1 yr. 4 m.	Complete for 6 m. Pain returned	F.	Note age at time of operation
(8) F. 55	3 yrs.	A.	2 yrs. 4 m.	Complete	G.	Walks well and works in garden.
(9) M. 55	5 yrs.	A.	1 yr. 3 m.	Complete for 1 yr. Slight recurrence	G.	
(10) M. 68	3 yrs.	A.	1 yr. 3 m.	Complete for 2 m. then relapse	B.	
(11) F. 63	2 yrs.	A.	1 yr. 4 m.	Complete	G.	Bedridden with pain before
(12) M. 67	8 yrs.	D.	3 weeks	Complete	G.	Died at stool. P.M. showed both coronaries grossly diseased
(13) M. 57	7 yrs.	A.	1 yr. 6 m.	Nearly complete. Very occasional pain hurrying	G.	
(14) M. 67	3 yrs.	A.	1 yr. 2 m.	Complete for 1 yr. Pain on hurrying lately	F.	Previously bedridden. Walked 2 miles a day till recently
(15) F. 18	1 yr.	A.	1 yr. 3 m.	Complete	G.	Extreme aortic incompetence (rheumatic). Pain previously on slightest exertion

Points worth noting are the duration of the successful post-operative course, the amount of exercise freely taken during this time, the age of patient No. 7 at the time

of operation, and the fact that patient No. 12 proved a good operative risk, although the post-mortem three weeks later showed that both coronaries were grossly diseased. This patient also had a bundle branch lesion. His pain, however, was so extreme that the operation was done with full knowledge that the heart was extremely diseased.

The indications for thyroidectomy are : The diagnosis is certain. The pain is very severe and shows no sign of diminution after a sufficient spell of treatment by other means. No recent coronary infarction shall have occurred, for angina of effort following this is apt to disappear spontaneously.

The chief contra-indications are : Adiposity, a visibly progressive cardiac lesion, advanced myocardial degeneration, and the presence of severe renal or other disease.

The post-operative treatment comprises rest in bed for three to five weeks. No thyroid is given until slight signs of myxœdema, such as increase in weight, slight lethargy and sensitivity to cold begin to appear, then sufficient thyroid extract to remove these slight symptoms is given, the usual dose amounting to about gr. ½ four to six times per week.

Revascularization operations have been a matter of practical politics since the work of Beck (Beck, C. S., *Surg., Gyn. and Obstet.*, 1937, **64**, 270) and O'Shaughnessy (D. T. D. Davies, H. E. Mansell, L. O'Shaughnessy, *Lancet*, 1938 (i), 76). Does revascularization occur in man as a result of such surgical operations ? What is the post-mortem evidence ?

Of five cases, done at St. Bartholomew's Hospital, one died immediately after the operation, and a second one year and four months after. The latter had suffered from practically no pain since the operation but had complained of increasing dyspnœa. At post-mortem the investigation showed no evidence of revascularization. Of the other three cases, one stated that the pain was 75% better but still complained of dyspnœa, one states that the pain is now very slight and that he can walk two miles at a moderate pace, and the fifth case walks normally and is well two years and six months after the operation.

The following pathological considerations are important :—

Attention should be focused upon the state of the recipient muscle. Angina of effort of a severe degree indicates coronary disease with living muscle fibres beyond, which are periodically starved of their blood supply. This would seem to provide a fertile field for revascularization. Previous coronary infarction, and *a fortiori* several such infarctions, would seem to be a less good indication for this form of treatment. Fibrous tissue is not a good or a useful recipient, if it is a possible one. The field would here seem to be extremely stony. It is conceivable in future that electrocardiographic investigation of patients by exercise or with anoxæmia might bring out cardiographic changes due to coronary disease which would enable us to diagnose the position of the anoxæmic area, whether anterior or posterior. It would seem that omentopexy of the left ventricle might not be useful if the posterior coronary circulation is the one causing symptoms. Although revascularization is obviously the most scientific form of surgical approach to the problem, in view of the many difficulties existing at present, it would seem that the relief of cardiac pain of a coronary type is best achieved either by thyroidectomy or by alcohol injection, in the hands of an expert.

Professor J. Paterson Ross : *Revascularization of the myocardium.*—Angina of effort may be likened to the limb pain of intermittent claudication, the reason for both being found in the relative ischæmia of a working muscle. Disease of the coronary arteries having produced an obstacle to the free passage of blood

to the heart muscle, the ideal treatment would appear to be the provision of a fresh blood supply.

It is for this reason that I place the operations of muscle grafting or omental grafting first among the surgical procedures for the relief of angina. The function of the omentum in providing a blood supply to infarcted portions of abdominal viscera is well known ; cases in which I have observed this phenomenon lead me to suppose that the operation of cardio-omentopexy has a sound theoretical foundation.

Total thyroidectomy.—The surgeon who wishes to remove every trace of thyroid tissue must be concerned about the preservation of the recurrent laryngeal nerves. No doubt the ideal method would be to display the nerve in every case, for by seeing it clearly it may be avoided, whether it runs anterior or posterior to the inferior thyroid artery ; and whether it is separated from the gland by a dense sheet of fascia, or runs, as it occasionally does, not only in close contact with but actually through the substance of the lateral lobe. I have preferred, however, to work carefully round the side of the lobe, keeping as close as possible to the capsule of the gland and stripping the fascial sheath off its surface, clipping all the branches of the vessels with mosquito forceps, and I have thus avoided injuring the nerve. Though it has frequently been seen it has not been exposed deliberately before removing the lobe.

This method may be rather more tedious than primary ligation of the inferior thyroid artery, exposure of the recurrent nerve, and subsequent excision of the gland, but it has the advantage of leaving the tissue outside the fascial sheath almost undisturbed. This is a matter of practical importance in avoiding injury to the parathyroid bodies, and of theoretical interest in that the damage to any of the sympathetic nerve-fibres which run close behind the gland must be minimal. The relief of pain after this operation has been just as striking and has occurred just as early as in cases recorded by other surgeons, which seems to refute the suggestion that thyroidectomy is effective not because thyroid tissue has been excised, but because sympathetic nerves have been severed.

Acting upon this suggestion, some of the Edinburgh surgeons have removed only the lateral lobes, leaving the isthmus to supply the thyroxin-requirements of the body, thus avoiding the necessity for post-operative thyroid medication. It will be interesting to hear the late results of their cases, but while not denying the existence of sympathetic fibres close behind the gland, it is hard to believe that the incidental damage to these nerves in the course of removal of the thyroid would give better results than the deliberate excision of the cervical sympathetic trunk and its cardiac branches.

The thyroxin factor must be important, since the administration of thyroid substance after the operation must be very carefully controlled to avoid the recurrence of pain which follows an overdose. It is quite likely that it may not be thyroxin itself which is directly responsible for the pain—it may be that its effect comes from sensitizing the tissues to circulating adrenaline—but in my opinion there is good reason to insist upon complete removal of the thyroid gland. Any tendency to myxœdema is easily controlled and patients are able to lead active and useful lives after the operation.

Sympathectomy.—Physiologists are not yet in entire agreement as to the functions of the complex sympathetic cardiac nerves. There is no doubt that they convey accelerator impulses, and the balance of the evidence is in favour of their being dilator nerves to the coronary arteries. The French and some American physiologists, however, believe that they convey vasoconstrictor impulses to these vessels, and Leriche sees in the stellate ganglion a reflex centre receiving afferent impulses from the heart and aorta which produce a pressor response resulting in a quickened heart beat and coronary constriction. Upon this conception he bases his argument

for stellate ganglionectomy, believing that the beneficial effect is due to the blocking of efferent rather than afferent impulses.

Here we favour the view that sympathectomy is beneficial because in dividing the sympathetic nerves we must also cut the visceral sensory fibres which accompany them, our object being, in fact, sensory denervation and not sympathectomy, except in so far as slowing the heart rate may be a relief to the under-nourished muscle.

Stellate ganglionectomy will block a large proportion of the afferent nerve-fibres from the heart, but as pain fibres enter the spinal nerves along the white rami of the upper four or five thoracic nerves complete sensory denervation involves a very extensive operation. Although it is often possible to reach as low as the 4th thoracic ganglion by the anterior approach to the cervicothoracic portion of the sympathetic chain, this may prove to be rather an extensive operation for a patient with heart disease, and therefore the alternative of alcohol injection has to be considered.

The correct placement of the alcohol can be shown (at the upper end of the injection area at all events) by signs of sympathetic paralysis, and, given a reasonable amount of practice, the method should be accurate enough to achieve its object. It has the drawback, however, that intercostal neuritis is a sequel which can hardly be avoided since the alcohol must affect the intercostal nerves as well as the rami communicantes. I would therefore prefer to excise the sympathetic trunk whenever the patient's condition permits it.

The risks of surgical intervention.—The majority of patients with angina stand the strain of operation surprisingly well. This strain can be reduced to the lowest possible limit by avoiding emotional excitement before the operation starts, and venous congestion during anæsthesia.

Cardio-omentopexy is to be regarded as a more formidable procedure than either sympathectomy or thyroidectomy ; alcohol injection may be undertaken when the latter operations are contra-indicated ; but whereas convalescence from either of these is likely to be uneventful, the neuritis following alcohol injection may prove to be a severe tax upon the patient's endurance.

The risk of sudden death after the patient has been deprived of his painful " danger-signal " has been over-stressed in the past. Many of our patients have observed a peculiar but painless sensation in the chest which still acts as a warning, but the improvement which occurs in the patient's general condition when he no longer suffers frequent attacks of severe pain more than compensates for the risk of over-straining an insensitive heart, and the increased exercise which the operation has permitted may even improve the nutrition of the myocardium as well as the state of the body as a whole.

As far as we know, sympathectomy merely blocks sensory impulses—the heart is exposed to the same strain as before but pain is not felt. The aim of thyroidectomy is to spare the heart by diminishing the work it has to do, and thus to avoid the effort which produces the pain.

Mr. A. Dickson Wright : Angina pectoris can be grouped into two classes :—

(1) Spurious cases in which the disease is simulated by neurotics or by other diseases like cholecystitis, pleurodynia, diaphragmatic hernia, &c.

(2) True cases : (*a*) With the heart functioning well in all other respects, these cases are often cured by some other event such as an emergency operation or major illness.

(*b*) With signs of heart dysfunction either primary or secondary to cholecystitis,

hyperpiesia, goitre, aneurism and tachycardia of the paroxysmal and effort syndrome types.

The surgical approach to angina is not much employed in this country because in a disease so associated with sudden death the physician tends to exclude the surgeon lest his ministrations should coincide with this event; also the patient under the shadow of heart disease shuns the operation though possibly not so much as his dependants who do not suffer the pain.

Surgical Treatment

Secondary angina.—(*a*) Gall-bladder disease should be eradicated; quite dramatic results are obtained in this group.

(*b*) Hypertensive cases. If there are definite signs that the blood-pressure is labile and kidneys are undamaged, splanchnic and lumbar ganglionic resection is indicated. In a series of 32 of these cases I have had three with angina and they have all benefited by operation.

(*c*) Paroxysmal tachycardia can be cured by operations on the upper five thoracic ganglia on the right side, and associated angina disappears with the tachycardia.

(*d*) Effort syndrome. There may be some hope in this almost hopeless malady by disconnecting the heart from its badly behaving accelerator nerves.

(*e*) Aortic aneurism. In two cases I have anastomosed external carotid and external jugular and the resulting drop in blood-pressure has helped the pain.

Primary angina.—The surgical method of attack may take several forms:—

(*a*) Division of the sympathetic nerves of the heart. It is probable that this operation not only stops the pain but also helps the heart by reducing vasoconstriction of the coronary arteries and by eliminating pressor and accelerator impulses carried by these nerves. In a disease checked so magically by vasodilator drugs there is hope in an attack upon the vasoconstrictor nerves. The operation to relieve pain is directed towards the upper thoracic ganglia on the *left* side. The large published mortality from this operation is out of date and applies to the posterior mediastinal approach. There is practically no mortality in the safe anterior approach designed by Paterson Ross.

(*b*) Alcohol injection of the upper five dorsal ganglia on the left side in the hands of White produces remarkable results. My own feeling is to restrict this to cases with heart failure and employ the operation with its greater precision upon the less ill patients.

The criticism made against these operations on the nerves of the heart is twofold. Firstly the removal of the pain is stated to remove a valuable inhibition, saving the patient from excessive effort. The answer to this is that there are other sensations which will still check the patient after operation such as epigastric or right-sided discomfort and dyspnœa. The second objection is that by denerving the heart valuable stimuli to the heart are lost and its effort cannot be mobilized when required. Here the answer is that the large number of patients sympathectomized for Raynaud's disease make no such complaint.

(*c*) Total thyroidectomy has now been given a very good trial, and excellent results have been obtained and so quickly, that it has been suggested that some of the sensory cardiac nerves are divided in the course of the operation. I feel strongly that this operation should be confined to patients far gone in heart failure and that here it is of great value. Denerving operations do not interfere with the patient's physiology so much and are less mutilating.

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(*d*) Revascularization operations are attractive in theory but are open to the following criticisms : Throughout the body it is impossible to induce any organ to take up a new blood supply when its own is intact, and after all the heart muscle is only short of blood during infarction.

After infarction no amount of revascularization will make fibrous scars of infarcts become contracting muscle again, and as fibrous tissue they will not require or acquire a new blood supply.

The operations have a high mortality. I feel that there is only one class of case where they might be justified, familial coronary thrombophilia in which all the male members succumb to coronary thrombosis early in the fifth decade of life.

Coronary thrombosis.—Surgery may be of some value here ; especially valuable have I found the injection of the left upper thoracic ganglia with novocain to reduce the pain and possibly remove vasoconstriction. The heparin constant intravenous drip prevents extension of the thrombosis in the coronary vessels and absolutely stops the formation of those mural thrombi over the infarcted area which cause dangerous embolic accidents just when the patient is emerging from the cardiac wood.

Dr. H. E. Mansell : *Palliative operations.*—The surgeon aims, either directly or indirectly, at relieving the patient of pain. The direct method is to interrupt the afferent nerve paths from the heart either by actual sympathectomy or preferably by injection. Protocain can be used more freely than alcohol, and does not produce neuritis. Its effect lasts for months, and the method is of value for patients who are unsuitable for operation. The indirect method is total thyroidectomy. One certain result of this is a lowering of the basal metabolic rate, which is likely to spare the patient's heart in much the same way that medical management does. The method is indicated where angina is associated with hyperthyroidism.

Radical operations.—These are designed to deal with one or other of the two causal factors in angina, coronary spasm and coronary disease. It seems probable that thyroidectomy acts chiefly by removing the source of circulating thyroxin and thus diminishing coronary spasm. An ingenious operation has been recently described by Raney (1939), who postulated that, whereas normally the sympathetic causes coronary dilatation, in anginal patients this action is reversed and coronary constriction results. In evidence he mentions other features of angina which suggest sympathetic activity such as peripheral vasoconstriction, tachycardia, sweating, and gastric dilatation, and also the ease with which nitrites cut short an attack and adrenaline provokes one. His operation consists in dividing the preganglionic rami of the 2nd to 5th thoracic ganglia and also the sympathetic chain between the 5th and 6th ganglia, a procedure which interrupts the efferent paths while leaving the afferent untouched. He has operated on 11 patients without fatality and with complete success. At the Lambeth Cardiovascular Clinic his operation has been performed once so far, the patient being a woman with typical angina of effort, in whom the electrocardiogram was normal and an attack could be provoked by adrenaline.

None of the foregoing operations attacks coronary disease itself nor avails to prevent coronary thrombosis, a complication which proved fatal to some of Dr. Bourne's patients even after successful thyroidectomy. Surgical revascularization is essential, and although the best technique and even the ideal grafting tissue may be yet undiscovered I remain convinced that the conception is fundamentally sound and a practical possibility. Let me conclude with a few points about cardio-omentopexy. The graft is conceived as linking up with the coronary tree, so that its revascularizing effect is general, not local. Hence the ideal indication should be

specific aortitis with narrowing of the coronary orifices. I agree with Dr. Bourne that the operation is seldom indicated in cases of cardiac infarction, for the patient either improves spontaneously or is left with a large area of fibrosis in his heart which would remain unaffected by a graft. Our experience has shown that the use of aleuronat is unjustifiable owing to the risk of the pericarditis proving fatal. The approach via Larrey's angle provides an excellent view of the left ventricle for suturing the graft, and does not involve paralysis of the diaphragm. Gall-bladder disease must be excluded, and where angina is secondary to hyperpiesia the latter must be treated, and cardio-omentopexy is contra-indicated. It is also important to exclude, if possible, gross atheroma of the abdominal aorta, which is the ultimate source of the omental blood supply. Seven out of our original 15 cases of angina pectoris (Davies, Mansell and O'Shaughnessy, 1938) have died. One patient succumbed at operation, and in the case of another, post-mortem examination was refused. In four out of the remaining five patients vascular channels were found post mortem between omentum and left ventricle. In the fifth, who had shown improvement enough for him to return to work and who died suddenly, the graft was found lying free in the left pleural cavity. Aleuronat and not suture had been used at operation, and some vascular intrapericardial adhesions had formed, which may have been responsible for his temporary improvement. Finally, it is pertinent to the present discussion to mention that one of our patients, whose angina had persisted unabated by total thyroidectomy, has been almost completely relieved by cardio-omentopexy, and now can take enough thyroid to keep him free of myxœdema.

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Dr. Courtenay Evans : Dr. Geoffrey Bourne has asked me to refer to the electrocardiographic changes following anoxæmia using a 10% or 12% oxygen mixture. Following inhalations for two or three minutes I have found that the T wave changes occur in about half the patients with angina, whose resting tracing was normal. I have had satisfactory results from thyroidectomy, and one of my patients has been free from pain (previously almost unbearable) for two years ; pain recurs if too much thyroid is given ; $\frac{1}{3}$ gr. a day has kept him free from myxœdema. During the past six months I have been treating severe cases by alcohol injection of the sympathetic dorsal ganglia. My colleague at the Royal Chest Hospital, Mr. Ian Robin, has been very successful in carrying out this treatment—only the upper two dorsal ganglia on both sides have been injected in four cases, and so far the pain has been relieved. I have noticed an immediate severe fall of blood-pressure and collapse of the patient, sometimes with vomiting, when the ganglion is reached, but without any serious result. It is most important that the actual ganglia should be injected and the occurrence of Horner's syndrome is a good indication that the technique has been successful. This treatment necessitates only a few days' stay in hospital and is much less severe than either thyroidectomy or cardio-omentopexy.

The Chairman : I have seen many anginal patients during many years, but only one of them have I submitted to surgical treatment. As I tell all my anginal patients, this is a much maligned disease. We are impressed by those unfortunates who succumb to or are crippled by coronary infarction ; we forget those very numerous patients who live to a ripe old age in spite of their angina, or die from some other disease. Some of them in fact cease to have angina ; others learn so to regulate their lives as not to be worried by anginal pain. Nevertheless I agree that there is a

limited scope for surgery in the treatment of this disease. The solitary patient of whom I spoke just now is aged 65. Angina followed a coronary thrombosis in 1928. He was able to work till 1934, when angina of decubitus first appeared. In 1935 he began to have frequent attacks of acute pulmonary œdema. When seen by me in April 1936 he had been confined to bed for four months, there were frequent attacks of acute pulmonary œdema with pink sputum, and anginal pain was brought on by the least effort. Blood-pressure 190/125. Heart grossly enlarged. Bundle branch block.

Total thyroidectomy was performed by Mr. Hamilton Bailey, April 5, 1936. On May 20, 1936, walking out of doors without angina or dyspnœa.

February 17, 1940, he wrote : " I have had no severe angina since the thyroid operation. In my opinion there is no doubt of the value of thyroidectomy."

Surgery may also be considered in those cases where the patient is more or less completely incapacitated by frequent and severe anginal attacks, brought on with slight provocation, but where there is no evidence of serious coronary or myocardial disease. For instance, a man of 62 had angina of effort nine years. For four years he has averaged 20 tab. trinitrini daily. He works hard as a builder. Blood-pressure 160/90. Radiographically heart not enlarged. Electrocardiogram stationary and normal for four years, but now, after effort, coronary electrocardiographic changes appear temporarily.

In this type of case some form of sympathectomy is, I believe, justifiable.